

Children Who Are Shot: A 30-Year Experience

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● Three data sets describe the pattern of gunshot injuries to children from 1960 to 1993: The Harlem Hospital pediatric trauma registry (HHPTR), the northern Manhattan injury surveillance system (NMISS) a population-based study, and the National Pediatric Trauma Registry (NPTR). A small case-control study compares the characteristics of injured children with a control group. Before 1970 gunshot injuries to Harlem children were rare. In 1971 an initial rise in pediatric gunshot admissions occurred, and by 1988 pediatric gunshot injuries at Harlem Hospital had peaked at 33. Population-based data through NMISS showed that the gunshot rate for Central Harlem children 10 to 16 years of age rose from 64.6 per 100,000 in 1986 to 267.6 per 100,000 in 1987, a 400% increase. The case fatality for children admitted to Harlem Hospital (1960 to 1993) was 3%, usually because of brain injury, but the majority of deaths occurred before hospitalization. During the same period, felony drug arrests in Harlem increased by 163%. The neighboring South Bronx experienced the same increase in gunshot wound admissions and felony arrests from 1986 to 1993. The NPTR showed a similar injury pattern for other communities in the United States. In a case-control analysis, Harlem adolescents who had sustained gunshot wounds were more likely to have dropped out of school, to have lived in a household without a biological parent, to have experienced parental death, and to have known of a relative or friend who had been shot than community adolescents treated for other medical or surgical problems. Since 1990, the Harlem Injury Prevention Program formed a coalition of school and community organizations joined by the District Attorney's Office in collaboration with the Tactical Narcotic Team (to eliminate drug selling from the schools and playgrounds), to provide safe, supervised activities for children. Data from 1990 to 1992 show a moderate

decline in the incidence of gunshot wounds to children. Gun control legislation in conjunction with the community violence prevention activities are needed to curb the epidemic of gunshot injuries.

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THIS ARTICLE describes the pattern of gunshot injuries to Harlem children from 1960 to 1993 and compares this experience with that of the neighboring community of the South Bronx and with trauma centers around the country. It is hypothesized that the absence of a parent or extracurricular activities or employment is associated with risk for gunshot injury.

MATERIALS AND METHODS

Harlem Hospital, located in Northern Manhattan, the only hospital in Central Harlem, is a Level I Trauma Center and provides care for the majority of the local residents. Central Harlem is an economically disadvantaged, predominantly African-American community of 121,995 inhabitants with 29% of the population (1980 census) younger than 17 years of age.

The present study uses three data sources: (1) The Harlem Hospital Pediatric Trauma Registry (HHPTR) records medical and social data on all children up to 17 years of age admitted for injury, excluding ingestions, foreign bodies, and burns. This hospital registry began in 1970, and information for prior years was obtained through chart review. The Lincoln Hospital Trauma Registry, begun in 1986, was compared with the Harlem Hospital data. (2) The Northern Manhattan Injury Surveillance System (NMISS), started in 1983, provided on-going population-based surveillance of severe pediatric injuries for children under 17 years of age residing in Central and West Harlem. NMISS includes data on all pediatric injuries resulting in hospitalization and/or death. Using methods described by Davidson et al,¹ census data from 1980 and 1990 provide population estimates for computation of annual incidence rates. (3) The National Pediatric Trauma Registry (NPTR), founded in 1985, currently accepts trauma data from 61 general and children's hospital trauma centers around the country.^{2,3}

In a case control study, during 1993 to 1994, outpatient and inpatient Harlem children who sustained gunshot wounds are compared with age- and gender-matched children who are seen in the medical clinic or are hospitalized for other injuries. Data on family structure, school attendance, job experience, participation in sports, prison history, exposure to violence, and urine toxicology are collected for cases and controls.

RESULTS

From 1960 to 1993, 372 children were admitted to Harlem Hospital for gunshot wound (Fig 1). Only 2 children were admitted from 1960 to 1969. From 1970 to 1979, 88 children were admitted; in 1980 to 1989,

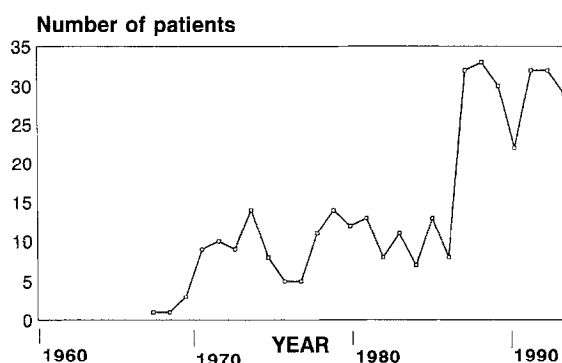
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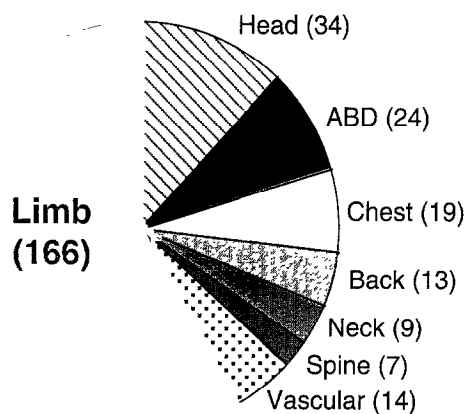


N=372

Fig 1. Pediatric gunshot wound admissions (ages 0 to 17 years) to Harlem Hospital for the years 1960 to 1993. Data from the Harlem Hospital Pediatric Trauma Registry.

167 children; and from 1990 to 1993, 115 were admitted to the hospital. Of the hospitalized children, 302 (81%) were boys and 70 (19%) were girls. Eighty-three percent were between the ages of 10 and 16 years; the mean age was 13.8 years, the range 1 to 17 years. For the years 1970 to 1981, the nature and site of the injuries was reported by Barlow et al.⁴ For the years 1982 to 1993, 257 children were hospitalized. As in the first series, the commonest site of injury was the extremity, and the most lethal, head injury (Fig 2). The case fatality for the 30-year period (1960 to 1991) is 3%.

The northern Manhattan injury surveillance system (1983 to 1992) showed that the gunshot injury rate for children 10 to 16 years of age rose from 64.6 per 100,000 in 1986 to 267.6 per 100,000 in 1987, a 400% rise (Table 1). During this period, 15 of the 18 child deaths (83%) of gunshot occurred before the child reached the hospital, and children 10 to 16 years represented 89% of all gunshot fatalities in Central



N = 257 Children

Fig 2. Pediatric gunshot wound injury sites for children admitted to Harlem Hospital from 1982 to 1993. The first series of children (1971 to 1981) was reported by Barlow et al.⁴

Table 1. NMISS Gunshot Injury and Death Rates per 100,000 Central Harlem Children Aged 10 to 16 Years (1983 to 1992)

Year	Injury Rate per 100,000	Death Rate per 100,000
1983	101.9	0
1984	34.5	0
1985	20.1	8.4
1986	64.6	17.1
1987	267.6	26.1
1988	184.2	0
1989	217.8	18.0
1990	170.8	18.3
1991	152.5	0
1992	110.8	9.2

Harlem. For children 10 to 16 years of age, the death rate steadily increased, peaking in 1987 at 26.1 per 100,000, with an average rate for the 9 years of 9.7 per 100,000. Since 1990, the injury rate for this group has shown a moderate decline.

Lincoln Hospital in the South Bronx, an economically disadvantaged, predominantly Hispanic community, experienced a similar epidemic of childhood gunshot injuries, as noted in Fig 3.

From 1986 to 1993, the proportion of children injured by gunshot wounds for Harlem Hospital increased steadily, from an initial value of 4.7% in 1986 to 16.4% in 1992, and in the last 4 years (1989 to 1992) has averaged 14%. Data from the National Pediatric Trauma Registry were examined to determine if the Harlem experience was unique. These data show that the proportion of trauma admissions attributable to gunshot in both general and children's hospitals show a similar, if less dramatic, increase for the same period nationally. However, general hospitals, at a rate of 8%, cared for proportionally more gunshot wound victims than children's hospitals, at a rate of 4%. The case fatality for the 8 years for all

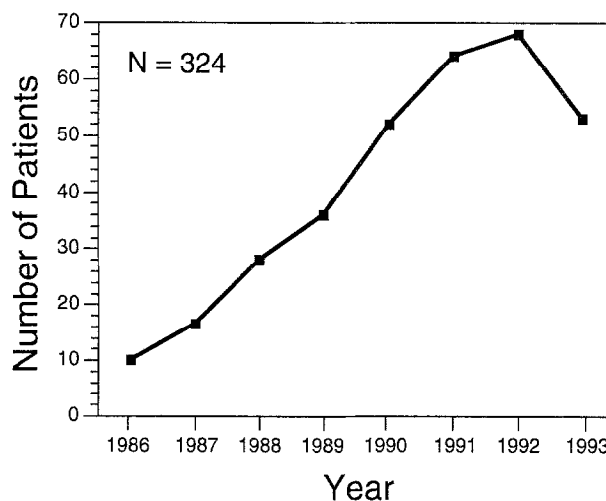


Fig 3. Pediatric gunshot wound admissions to Lincoln Hospital from 1986 to 1993. Data from the Lincoln Hospital Trauma Registry.

Table 2. Risk Factors for Adolescent Gunshot Injury in Central Harlem and Controls Seen for Medical Visits or Other Injuries

	Percentage	
	Gunshot Wound Patients (n = 26)	Controls (n = 34)
School drop-out	31	0*
Part-time job	4	21
Sports	15	35
Jail	12	0
Household		
Two-parent	19	32
One-parent	31	35
Nonparent	50	32
Parental death	38	12*

**P* < .05.

centers exclusive of Harlem Hospital averaged 11.2%. For the same period the case fatality for Harlem Hospital was 3.2%.

Possible risk factors for injury were examined in the 1993 to 1994 case control study (Table 2). Initial results show that children who had been shot reported few extracurricular activities or work experiences compared with the control group of outpatient or inpatient children who had not been shot. School drop out and prior exposure to the criminal justice system were seen only in the gunshot wound group. Toxicology was performed only on hospitalized children. Sixty percent of gunshot-wounded children had positive toxicology (predominantly marijuana) compared with 20% of control children. Children who had been shot were less likely to live in either a two-parent or one-parent household and more likely to report living with a nonparent and to have experienced parental death.

Felony drug arrests from the Commissioner of Police were available for both the Central and South Bronx communities. Between 1986 and 1990, the data show a steady increase in drug arrests over the period corresponding to the escalation of pediatric gunshot wounds.

DISCUSSION

Three data sets, the Harlem Hospital pediatric trauma registry, the Northern Manhattan Injury Surveillance System providing population-based data, and the National Pediatric Trauma Registry are used to show the escalating national problem of gunshot injuries to children, especially adolescents. Gunshot injury, a rare event in children in Central Harlem before 1970, now represents over 15% of trauma admissions to Harlem Hospital and at least 5% of trauma admissions to 61 trauma centers around the United States. The Harlem experience is not unique and is shown in the adjacent community of the South Bronx. These experiences are in sharp contrast to the

available NPTR data from Toronto, Canada, for the years 1986 and 1992, with less than 1/2% of trauma admissions attributable to gunshot.² The contrast in the rates of crime, assaults, and homicides in two cities, Vancouver and Seattle, with differing handgun regulations, has been used to strongly support gun control as effective in the primary prevention of gunshot injuries and deaths.⁵

The pattern of injury to children indicates a stable case fatality of 3% for hospitalized Central Harlem children over the 30-year period. Head injury is responsible for most of the fatalities. This case fatality is lower than the overall case fatality for hospitalized children as reported through the National Pediatric Trauma Registry. Availability of population-based data through the Northern Manhattan Surveillance System shows, similar to the findings reported by Cooper et al,⁶ that 83% of Central Harlem child deaths from gunshot occurred before hospitalization and therefore are not represented by either the hospital trauma registry or the National Pediatric Trauma Registry. Eighty-nine percent of deaths occurred to adolescents aged 10 to 16 years. From the Harlem data, because head injury was the predominant cause of death from gunshot, it is unlikely that prehospital care will impact on the death rate. Instead these data strongly suggest that only primary prevention through gun control will reduce child deaths.

Nationally, general hospitals with trauma centers have borne the brunt of this epidemic with approximately 8% of trauma admissions attributable to gunshot as compared with less than 4% for children's hospitals.

An increase in felony drug arrests in Harlem and the South Bronx parallels the increase in gunshot injuries to children in these communities. In 1982, Barlow et al⁴ and colleagues suggested that the 1973 New York State drug possession law that imposed mandatory sentences for adults offered an explanation for the recruitment of children 12 to 16 to sell drugs on the street. Knowledge of a range of risk factors for injured children is important in suggesting interventions. The present data support the hypothesis of the protective effects of a parental figure, school, and extracurricular activities, as has been suggested by other studies.^{7,8} The current sample size for our case control study is small; more data are needed to confirm these initial results.

The current approach to violence in the Central Harlem community through the Harlem Hospital Injury Prevention Program includes the development of youth programs that promote safe activities and provide a safe environment.^{9,10} HHIPP is addressing

violence prevention in collaboration with groups such as Juvenile Justice, the Tactical Narcotic Task Force, the District Attorney's community outreach program, schools, and community-based organizations. The antiviolence program is being evaluated using the trauma registries and the NMISS, as well as case follow-up.

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Discussion

M. Hirsch (Pittsburgh, PA): I want to thank Drs Laraque and Barlow for the opportunity to review this manuscript and applaud the efforts of Harlem Hospital Medical Center to chronicle this population-based study of 30 years of gunshot wound experience in children.

Despite the quality of these data, I think there are some dangers inherent in suppositions about the reasons for some of the fluctuation in the gunshot wound incidence.

The manuscript that you provided indicated that there was a supposition about an increase in violence related to a New York gun control law that was instituted in the early 1970s that might have pushed drug running into the hands of the pediatric population, and then the crack epidemic that you chronicle in the late 1980s as another reason for an increase in gunshot wounds was also listed as a contribution. In the injury rate that you described from the northern Manhattan project, there was also at least a supposition made that perhaps some of the violence prevention programs you mentioned might have been related to the diminution in the injury rate.

In order to make those kinds of suppositions we have to at least be sure that some of the phenomena you are describing are not just redistribution to other parts of the city. I know that some of the data from Lincoln Hospital is encouraging that it is not strictly that, but I wonder if the authors could comment on

some city-wide data that does not just show that your injury prevention programs have pushed some of this violence to other parts of the city.

The other inference that you make very good use of is that gunshot wound fatality cannot really be affected by better trauma systems because most of these deaths occur before the kids ever enter the trauma systems.

Looking at some of the sociodemographic data of the gunshot wound victims in your manuscript it seems like a Herculean task when you look at all the children that might fit the profile of the kid that's likely to get shot, the child who has lost a parent or is out of school, has no employment, or is a victim of abuse. Because you are only really reporting kids who have been admitted or potentially killed, I think you are also only looking at the tip of the iceberg. There are a lot of kids out there who are at risk.

I wonder if you might comment a little bit more in detail about what combinations of prevention programs other than just gun control efforts you're using. Is this gun control, gun safety, conflict resolution, peer mediation? And what ages are you targeting for kids to get these prevention programs?

D. Laraque (response): Thank you for all your comments; you point to some important issues.

First of all, one of the advantages of using population-based data and comparing them with hospital admissions is exactly what you say, that you may

falsely conclude that you have either a decrease or an increase based on your own hospital if you do not look at population-based data. Population-based injury rates reflect all gunshot injuries regardless of where the child is hospitalized. Trends can be derived and conclusions made of the effectiveness of particular interventions in a community.

Davidson and colleagues looked at the impact of the injury prevention program, Safekids/Healthy Neighborhood, a coalition of community organizations with Harlem Hospital Injury Prevention Program as the lead agency, and documented the effect of this intervention compared with a control community. The authors did show a decrease in severe injuries to children in the central Harlem community as compared to the control community; however, there was some contamination of the intervention with kids involved in our program coming from the control community. So I think there are difficult issues that we will need to track with data. The advantage of having multiple data sets, as we described, is that it allows us to control for some of these difficulties.

In terms of the profile of which kids are at risk, I think you are absolutely right. This is a preliminary study that begins to look at what some of the risk factors might be. At Harlem we are very alert to the fact that we want to look at protective factors, and not only at what places a young person at risk for gunshot injuries. We want to better understand the circumstances of those children who are not shot. We know more or less the profile of kids who are shot. We do not know the profile of the kids who in fact are dead and do not arrive at our hospitals.

In terms of your question about violence prevention, it is multifaceted. It is a complex problem, and gun control is but one possible solution. There are other examples, an elegant paper by the Seattle group has looked at Vancouver and Seattle and compared them. And certainly gun legislation has had a major impact, but it is not the only answer.

When we look at children and the profile of risk and the number of problems that they face, we believe that the better informed we are by the data, the better we can develop a community violence prevention response. Educational programs may not have an impact right away, but we have to begin to look at long-term outcomes.

R. Solenberger (San Antonio, TX): We have a very thriving trauma business at our hospital. I wrote a

letter to the Academy Newsletter 2 years ago in which we targeted specifically a subset of teenagers that are dealing drugs and are armed by the drug dealers who are wallowing in money.

Now, this started out with a 16-year-old who came to our institution in shock with six entrance and exit wounds who was accompanied by his homosexual lover, his common-law 13-year-old wife, his probation officer, and just about every other type of authority.

The question that I would have is, are you willing to admit there is a subset of teenagers that really are predators? Because in your presentation it appears as though the attitude is everybody can be brought around by education.

The second thing is that in your abstract you talked about an accompanying increase in felony convictions and arrests that is quite high. Could this by any chance be a lead-in toward part of the solution; and that is, more vigorous arrests and prosecution?

In San Antonio we have been able to break the power of the gangs by actually dedicating police teams that go after them for repeat offenders. That seems to be working. Would this also be a methodology that should be approached and backed by your institutions?

D. Laraque (response): Maybe I can answer the last part first. The felony arrests have paralleled the increase, so the hypothesis here is that it is because of the drug trade that we are seeing increasing gun use, and that this results in increased gunshot injuries and increased felony drug arrests.

Our paper simply documents that a rise in gunshot injuries has paralleled the increase in drug felony arrests. Whether the intervention this suggests is more arrests for drugs, I don't know. I think that this is certainly not primary prevention. We have to look at the broader issues of drug use, drug selling, and the most appropriate interventions. Punitive interventions at the community level may not be the most effective in the final analysis.

I think your first question had to do with whether or not there is a subset of adolescents that may not be amenable to change. Yes, sure. We had 15 of our 18 deaths before hospitalization and we never reached those kids. An alternatives-to-violence program can impact only in a small way unless we begin to look at the complex problem of interpersonal/societal violence and address it with better communication, safe activities, and more opportunities for young people to stay out of trouble before they get into trouble.